August 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

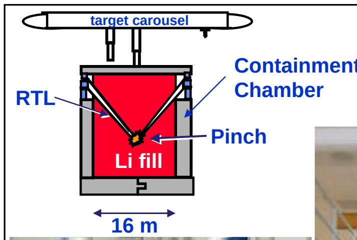

Fig. 1. RTL schematic for z-pinch power plant.

Fig. 2. Left: putting lens for Z-Beamlet in mounting hardware; right: installing 1ω diagnostics package.

Following a recommendation by the Garwin review panel (June 00 *Highlights*), we will convene expert groups and a user advisory committee to allocate shots on Z. The expert groups, which include collaborators from other laboratories, will discuss and prioritize the experiments and near-term capability development proposed in six research areas (ICF, pulsed power technology, material dynamics, secondary certification, hostile environments, and basic science). The advisory committee, composed of representatives from other Defense Program laboratories, DOE, and DTRA, will validate the technical merit and programmatic importance of the proposed experiments and enabling capabilities. Because of the lead time to design and fabricate hardware, the process will be first applied to the Jan.-Mar. 01 schedule. In FY01, we expect to approach the rate of ~200 shots per year on Z.

We had 8 Z shots in August. A scheduled vacuum stack rebuild was done from August 3 - 16. The Z shots were: a second dynamic hohlraum (DH) shot to assess the effects of instabilities on capsule radiation symmetry, a long-pulse short circuit shot, a z-pinch power flow shot to benchmark Z performance following the stack rebuild, a wire initiation shot, 3 z-pinch-driven hohlraum shots to evaluate capsule radiation symmetry, and a LANL weapon physics shot using a DH x-ray source.

In today's z-pinch devices, electrical power is supplied to the z-pinch load through magnetically-insulated transmission lines, usually made of stainless-steel. A rep-rated z-pinch power plant concept for inertial fusion energy is being developed. This concept uses a Recyclable Transmission Line (RTL), as shown in Fig. 1, that could be made from a suitable power plant coolant material (e.g., Li or FLiBe) with a thin, electrically-conducting overlayer. As part of a Laboratory Directed Research & Development project we are evaluating, in Saturn tests, materials that might be suitable for RTLs or the coating (Al, tin, or carbon).

We are continuing to prepare Z-Beamlet for operation with Z with the assistance of LLNL, AWE, and GSI personnel. Since April, we have assembled and tested the amplifier modules and installed the lens, mirror, and 1ω diagnostics package (Fig. 2). The first backlighting experiments, scheduled for December, are now expected to be in April because of a funding delay and unanticipated technical difficulties in activating the master oscillator and assembling the main amplifier units. An external web site (http://www.z-beamlet.sandia.gov) provides information on the project status via monthly photographs.

We have developed a magnetically-driven shutter, 51 cm from the center of Z, to reduce debris from z-pinch implosions that could reach an x-ray imaging camera to be used with Z-Beamlet. The shutter, designed with the SLINGSHOT code, uses a pulsed electromagnet to accelerate an aluminum cylinder across the camera's line of sight. A tapered, high-strength steel catcher slows the shutter and locks it in position. In characterization tests, the shutter closed in 175 μs--10 times faster than the pneumatic fast valves that protect diagnostics outside the Z target chamber. With the magnetically-driven shutter, debris would have to travel at >2.9 km/s to reach the camera film package. On an upcoming Z shot, we will verify that the shutter is fast enough. Explosively-driven shutters can close faster; however, they did not seem practical because of space constraints, integration with existing hardware, and the need to use explosives.

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